INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

EMBEDDED SYSTEMS								
VI Semester: ECE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AECD42	Open Elective	3	-	-	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 48		
Prerequisite: Computer Organization and Architecture, Operating Systems								

I. COURSE OVERVIEW:
The aim of this course is to enhance understanding of fundamental knowledge of how to design the embedded system hardware and firmware. It focusses on embedded system design process, embedded C, interfacing modules, software development tools for debugging and testing of embedded applications, ARM and SHARC processor architectures and memory organization. This knowledge helps to the students in development of embedded hardware projects and models for engineering and scientific applications using embedded C.

II. COURSES OBJECTIVES:
The students will try to learn

I. The fundamental concepts of embedded computing, embedded C, RTOS and embedded software tools for implementing embedded systems.
II. Embedded software development tools for debugging and testing of embedded applications, architectures of ARM and SHARC processors.
III. Interfacing with external environments using sensors, actuators and communication in distributed embedded systems.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO 1 Summarize the concepts of Embedded Systems and formalisms for system design with examples.
CO 2 Analyze the Embedded Systems programming in C with Keil Integrated Development Environment (IDE).
CO 3 Demonstrate the principles of RTOS and the methods used for saving memory and power in real time environments.
CO 4 Make use of embedded software development tools for debugging and testing of embedded applications.
CO 5 Illustrate the architecture, memory organization and instruction level parallelism of ARM and SHARC processors used in Embedded Systems.
CO 6 Interpret the concepts of Internet of Things used in the embedded systems applications.

IV. COURSE CONTENT:

MODULE --I: EMBEDDED COMPUTING (09)
Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, complex systems and microprocessor, classification, major application areas, the embedded system design process, characteristics and quality attributes of embedded systems, formalisms for system design, design examples.

MODULE –II: INTRODUCTION TO EMBEDDED C AND APPLICATIONS (10)
C looping structures, register allocation, function calls, pointer aliasing, structure arrangement, bit fields, unaligned data and endianness, inline functions and inline assembly, portability issues; Embedded systems programming in C, binding and running embedded C program in Keil IDE, dissecting the program, building the hardware; Basic techniques for reading and writing from I/O port pins, switch bounce; Applications: Switch bounce, LED interfacing, interfacing with keyboards, displays, D/A and A/D conversions, multiple interrupts, serial data communication using embedded C interfacing.

MODULE –III: RTOS FUNDAMENTALS AND PROGRAMMING (10)
Operating system basics, types of operating systems, tasks and task states, process and threads, multiprocessing and multitasking, how to choose an RTOS, task scheduling, semaphores and queues, hard real-time scheduling considerations, saving memory and power.

Task communication: Shared memory, message passing, remote procedure call and sockets; Task synchronization: Task communication synchronization issues, task synchronization techniques, device drivers.

MODULE –IV: EMBEDDED SOFTWARE DEVELOPMENT TOOLS (09)
Host and target machines, embedded system software development process and tools, compiler vs cross-compilers, assembler, types of files generated by the compilers, linker/locators for embedded software, getting embedded software into the target system; Debugging techniques: Testing on host machine, using laboratory tools, an example system.

MODULE –V: INTRODUCTION TO ADVANCED PROCESSOR (09)
Introduction to advanced architectures: ARM and SHARC, processor and memory organization and instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus; Internet-Enabled systems, design example-Elevator controller.

V. TEXT BOOKS:

1. Shibu K.V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd Edition, 2009.
2. Raj Kamal, “Embedded Systems: Architecture, Programming and Design”, Tata McGraw-Hill Education, 2nd Edition, 2011.
3. Andrew Sloss, Dominic Symes, Wright, “ARM System Developer’s Guide Designing and Optimizing System Software”, 1st Edition, 2004.

VI. REFERENCE BOOKS:

1. Wayne Wolf, “Computers as Components, Principles of Embedded Computing Systems Design”, Elsevier, 2nd Edition, 2009.
2. Dr. K. V. K. K. Prasad, “Embedded / Real-Time Systems: Concepts, Design & Programming”, Dreamtech publishers, 1st Edition, 2003.
3. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley & Sons, 3rd Edition, 2006.
4. Lyla B Das, “Embedded Systems”, Pearson Education, 1st Edition, 2012.
5. David E. Simon, “An Embedded Software Primer”, Addison-Wesley, 1st Edition, 1999.
6. Michael J.Pont, “Embedded C”, Pearson Education, 2nd Edition, 2008.

VII. ELECTRONICS RESOURCES:

1. NPTEL: Embedded Systems - NOC: Embedded Systems
2. NPTEL: Embedded Systems using ARM- NOC: Embedded Systems using ARM

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation